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Attorney Docket No. 01-562

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REMARKS

Please consider the following comments. Following this response, claims 1, 2, 4-16, and 26-31 are pending. Applicant respectfully requests reconsideration and allowance of this application in view of the above amendments and the following remarks.

Withdrawn Claims

By this response, Applicant has canceled withdrawn claims 17-25 without prejudice or disclaimer.

Claim Rejections – 35 U.S.C. § 103

The Examiner has rejected claims 1, 5, 7, 11, and 13 under 35 U.S.C. § 103(a) as being allegedly unpatentable over United States Patent No. 6,469,345 to Aoki et al. ("Aoki") in view of United States Patent No. 6,350,665 to Jin et al. ("Jin") and in view of United States Patent No. 6,784,101 to Yu et al. ("Yu"), and further in view of "Carrier Mobilities and Process Stability of Strained Si n- and p-mosfets in SiGe Virtual Substrates, by Currie et al. ("Currie").

Claims 1 recites forming a trench having an inner wall in a substrate; forming an insulation film on the inner wall of the trench; forming a conductive film in the trench on the insulation film; annealing the substrate for improvement of reliability of the insulation film at an annealing temperature after the step of forming the conductive film so that a damage in the insulation film is removed at the annealing temperature, wherein the annealing temperature is higher than 1150 degrees Celsius and is equal to or less than 1200 degrees Celsius. Similarly, claim 11 recites forming a trench having an inner wall in a substrate; forming an insulation film on the inner wall of the trench; forming a gate electrode in the trench on the insulation film; implanting an impurity into the substrate with using the gate electrode as a mask after the step of forming the gate electrode; performing a thermal diffusion process for diffusing the impurity so

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that a source region adjacent to the trench and disposed on a surface of the substrate is formed; and annealing the substrate for improvement of reliability of the insulation film at an annealing temperature after the step of forming the conductive film so that a damage in the insulation film is removed at the annealing temperature, wherein the annealing temperature is higher than 1150 degrees Celsius and is equal to or less than 1200 degrees Celsius. Nothing in Aoki, Jin, Yu, or Currie, alone or in combination, discloses or suggests these features.

The Examiner cites Aoki as allegedly showing the operation of forming a trench through its formation of a trench 6, the operation of forming an insulation film in its formation of the silicon-oxide film 7a, and the operation of forming a conductive film through its forming a gate electrode 8. (See, e.g., Aoki, column 2, line 48, through column 4, line 33, and FIG. 1, 2B, 2C, and 2G.) However, the Examiner acknowledges that Aoki fails to disclose annealing a substrate at an annealing temperature after the forming of the conductive film. For this teaching he relies upon a combination of Jin, Yu, and Currie. However, a careful examination of Jin, Yu, and Currie will show that they do not disclose or suggest an annealing operation as recited in claims 1 and 11.

Jin discloses that following an implantation of dopants to form a second diffusion region, a semiconductor device may be subject to a heat treatment such as an anneal (step 516). This Jin further notes that the anneal may repair lattice damage produced by previous ion implantation steps and/or result in some out-diffusion of dopants. (See, e.g., Jin, column 12, lines 43-53, and FIGs. 5A, 6G, and 6H.)

The Examiner asserts that it would have been obvious to one of ordinary skill in the art to incorporate the annealing step of Jin into the method of Aoki since an ordinary artisan would have been motivated to modify the method of Aoki in this manner for the purpose of repairing

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lattice damage produced by previous ion-implantation steps. Applicant respectfully traverses this assertion.

Claims 1 and 11 recite more than simply “annealing the substrate.” Rather, they recite “annealing the substrate for improvement of reliability of the insulation film at an annealing temperature *after the step of forming the conductive film* so that a damage in the insulation film is removed at the annealing temperature.” (Emphasis added.) Nothing in Jin, Yu, or Currie discloses or suggests that such an annealing process be performed after forming the conductive film.

The annealing step (516) that the Examiner cites in Jin is performed immediately after a second implant step (514) in order to repair lattice damage and/or produce out-diffusion of dopants. (See, e.g., Jin, column 12, lines 43-53, and FIGs. 5A, 6G, and 6H.) But Aoki already discloses a heating step in the formation of the P⁺ type or N⁺ type silicon substrate 1, the N⁻ type drift layer 2, the P type layer 3 and the N⁺ type layer 4. In particular, Aoki notes that “in a step shown in FIG. 2A, the N⁻ type drift layer 2 is formed on the P⁺ type or N⁺ type silicon substrate 1. Then, the P type layer 3 and the N⁺ type layer 4 as the source region are sequentially formed by ion-implantation and thermal diffusion.” (See, e.g., Aoki, column 3, lines 34-39, and FIG. 2A.)

Thus, to the extent that a thermal diffusion operation (e.g., an annealing step) might be desirable after an ion-implantation operation (e.g., to repair lattice damage and/or produce out-diffusion of dopants), Aoki *already* discloses such an operation – an operation performed *not* after the formation of the gate electrode 8 (which the Examiner cites as showing the recited conductive film), but well before. And nothing in Jin, Yu, or Currie gives any reason why one skilled in the art would want to add *another* thermal operation to the fabrication process of Aoki, specifically after the formation of the gate electrode 8.

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In fact, given limited thermal budgets (see, e.g., Currie, page 2275, column 2, lines 15-27), one skilled in the art would likely consider it a disadvantage to add an additional thermal operation to the process discloses in Aoki. Thus, the disclosures of Aoki, Jin, Yu, and Currie actually appear to actually teach away from their combination, since such a combination would frivolously waste the limited available thermal budget.

To properly reject a claimed invention, the examiner must establish a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness with respect to a claimed invention, all the claim limitations must be taught or suggested by the prior art reference (or references when combined). Moreover, there must be some reason, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Furthermore, the teaching or suggestion to make the claimed combination and a reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. The Examiner bears the burden of establishing this *prima facie* case. The Applicant for patent may then attack the *prima facie* case as improperly made out, or present objective evidence tending to support a conclusion of nonobviousness.

Where, as here, the Examiner fails to establish a *prima facie* case of obviousness, the applicant has no burden to rebut the rejection of obviousness with evidence. If the examination at the initial stage does not produce a *prima facie* case of unpatentability, then without more the applicant is entitled to grant of patent.

Claims 5 and 7 depend from claim 1 and are allowable for at least the reasons given above for claim 1. Claim 13 depends from claim 11 and is allowable for at least the reasons given above for claim 11.

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Therefore, for at least the reasons given above, Applicant respectfully requests that the Examiner withdraw the rejection of claims 1, 5, 7, 11, and 13 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, and in view of Yu, and further in view of Currie.

The Examiner has rejected claims 2, 4, 6, 8-10, 14, and 15 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki, Jin, Yu, and Currie, and further in view of United States Patent No. 6,455,378 to Inagawa et al. ("Inagawa").

Claims 2, 6, and 8-10 depend variously from claim 1 and are allowable for at least the reasons given above for claim 1. Claims 14 and 15 depends from claim 11 and are allowable for at least the reasons given above for claim 11.

Nothing in Inagawa cures the deficiencies in Aoki, Jin, Yu, and Currie noted above. In particular, nothing in Inagawa discloses or suggests an annealing of the substrate be performed after the step of forming the conductive film, as recited in claims 1 and 11. Furthermore, nothing in Inagawa provides any reason that one skilled in the art would want to combine the teachings of Jin, Yu, or Currie with those of Aoki as suggested by the Examiner.

In addition, with respect to claim 15, the Examiner concedes that Aoki, Jin, Yu, Currie, and Inagawa together fail to disclose the distance between the edge of a canopy and the edge of an opening of a trench being in the range of 0.05 micrometers and 0.1 micrometers.

Applicant therefore respectfully requests that the Examiner withdraw the rejection of claims 2, 6, 8-10, 14, and 15 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki, Jin, Yu, and Currie, and further in view of Inagawa.

The Examiner has rejected claim 15 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki, Jin, Yu, Currie, and Inagawa, and further in view of United States Patent No. 6,159,781 to Pan et al. ("Pan").

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Claim 15 depends from claim 11 and is allowable for at least the reasons given above for claim 11. Nothing in Pan cures the deficiencies in Aoki, Jin, Yu, Currie, and Inagawa noted above. In particular, nothing in Inagawa discloses or suggests an annealing of the substrate be performed after the step of forming the conductive film, as recited in claim 11.

Furthermore, Applicant notes that in this rejection, the Examiner is combining the teachings of six different references in order to obtain all of the limitations recited in claim 15. Applicant asserts that the Examiner is engaging in impermissible hindsight analysis, using the Applicant's own teachings to provide the reason to combine all of the individual elements of the recited claims. Nothing in any of Aoki, Jin, Yu, Currie, Inagawa, and Pan provide any reason why one of skill on the art would wish to combine all of their teachings in the particular manner suggested by the Examiner.

Applicant therefore respectfully requests that the Examiner withdraw the rejection of claim 15 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki, Jin, Yu, Currie, and Inagawa, and further in view of Pan.

The Examiner has rejected claim 12 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki, Jin, Yu, and Currie, and further in view of United States Patent No. 6,218,866 to Poplevine ("Poplevine").

Claim 12 depends from claim 11 and is allowable for at least the reasons given above for claim 11.

Nothing in Poplevine cures the deficiencies in Aoki, Jin, Yu, and Currie noted above. In particular, nothing in Poplevine discloses or suggests an annealing of the substrate be performed after the step of forming the conductive film, as recited in claim 11. Furthermore, nothing in

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Poplevine provides any reason why one skilled in the art would want to combine the teachings of Yu, Currie, or Jin with those of Aoki in the manner suggested by the Examiner.

Applicant therefore respectfully requests that the Examiner withdraw the rejection of claim 12 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki, Jin, Yu, and Currie, and further in view of Poplevine.

The Examiner has rejected claim 16 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki, Jin, Yu, and Currie, and further in view of United States Patent No. 6,218,300 to Narwankar et al. ("Narwankar").

Claim 16 depends from claim 11 and is allowable for at least the reasons given above for ~~claim 11~~.

Nothing in Narwankar cures the deficiencies in Aoki, Jin, Yu, and Currie noted above. In particular, nothing in Narwankar discloses or suggests that the annealing of the substrate be performed after the step of forming the conductive film, as recited in claims 1 and 11.

Furthermore, nothing in Narwankar provides any reason why one skilled in the art would want to combine the teachings of Yu, Currie, or Jin with those of Aoki in the manner suggested by the Examiner.

Applicant therefore respectfully requests that the Examiner withdraw the rejection of claim 16 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki, Jin, Yu, and Currie, and further in view of Narwankar.

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New Claims

By this response, Applicant has added new claims 26-31. No new matter has been added in these new claims. Applicant respectfully requests that the Examiner enter and consider these new claims.

Conclusion

Applicant respectfully submits that, as described above, the cited prior art does not show or suggest the combination of features recited in the claims. Applicant does not concede that the cited prior art shows any of the elements recited in the claims. However, applicant has provided specific examples of elements in the claims that are clearly not present in the cited prior art.

Applicant strongly emphasizes that one reviewing the prosecution history should not interpret any of the examples Applicant has described herein in connection with distinguishing over the prior art as limiting to those specific features in isolation. Rather, for the sake of simplicity, Applicant has provided examples of why the claims described above are distinguishable over the cited prior art.

In view of the foregoing, Applicant submits that this application is in condition for allowance. A timely notice to that effect is respectfully requested. If questions relating to patentability remain, the Examiner is invited to contact the undersigned by telephone.

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Although it is not anticipated that any additional fees are due or payable, the
Commissioner is hereby authorized to charge any fees that may be required to Deposit Account
No. 50-1147.

Respectfully submitted,



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